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The Urinary System of *Phlegethontius sexta* Johan. (Lepidoptera).

BY G. H. VANSELL.

(Contribution from the Zoölogical Laboratory of the University of Kentucky.)

PHLEGETHONTIUS SEXTA Johan., commonly known as the southern tobacco worm, is used in many laboratories for morphological study material. The paper of Alvah Peterson, published in the September number of the "Annals of the Entomological Society of America, 1912," treats the general anatomy of *Protoparce carolina* Linn., but the Malpighian tubules are not shown in his figures as fully as some other parts. If the conditions shown in the figures accompanying this paper differ from those found by Peterson in his work it may throw some light on the proposed synonomy of the species in question.

Malpighian tubules are usually two in number, or in multiples of two, and in most cases they empty directly, or through a bladder, into the intestine. In the larvæ of *Microgaster,* Koulagin found that they open dorsally on the outside of the body on each side of the anus. Those of *Phlegethontius sexta* Johan. empty into the small intestine.

The specimens used for dissection in this work were killed in various ways. Some were dropped into a solution of 50 per cent alcohol, 48 per cent water, and 2 per cent formalin. Immediately after death they were removed and the body wall split to allow the free passage of the preservative to the inside organs. At the time of use these specimens were further hardened by adding a solution of picric acid and chloral hydrate. Others were dropped into Bouin's picroformol mixture, and later run up through alcohols. Various stains

were used upon that material which was imbedded for sectioning. Borax carmine and Delafield's hemotoxylin seemed to give the best results.

The Malpighian tubules of *Phlegethontius sexta* are six in number and of a light yellowish color. Four of these are located largely laterodorsally to the intestinal tract, the other two being ventrally situated. Each tubule is apparently free at the end distad from the bladder. There are two bladders, located one on each side between the ventriculus and the small intestine (fig. 2), and just posterior to the ventriculus they empty separately into the small intestine through short, smooth tubes (fig. 3). From the opposite end of either bladder a tube arises which runs dorsally and branches immediately into two; one of these tubes runs ventrally and forward, the other dorsally, and this one divides into two more as it nears the top of the ventriculus. These six tubes run forward toward the head and turn back posteriorly at about the second abdominal segment, as shown in figures 5 and 6. Posterior to the bladders all these tubes interweave with the adipose tissue until they lose their identity.

On high magnification the tubes present an interesting appearance, in that each one is covered with small nodules. These nodules become more numerous on the tubes the greater the distance from the connection with the bladder, until at the distal ends the nodules are very closely crowded together (figs. 7 and 8). Tracheæ run to the tubes and branch into invisible threads upon the surface of the nodules (fig. 9).

Both the nodules and the tubes are hollow, and an opening from each nodule leads into the tube, making a continuous cavity to all parts (figs. 10, 11 and 12). The exact histological nature of the tubes is very hard to determine on account of their delicate nature. The figures showing these structures are not shown here, for more work is being done upon them and a later paper will appear.

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PLATE XXXVIII.

FIG. 1. Dorsal view of the region into which the Malpighian tubules empty. *bl,* bladder; *dd,* Dorsal duct; *ve,* ventriculus; *si,* small intestine.

FIG. 2. Ventral view of the same region. *bl,* bladder; *cd,* common bladder duct; *vd,* ventral duct; *dd,* dorsal duct; *n,* nodule on the Malpighian tubule; *si,* small intestine.

FIGS. 3, 4. Lateral view, showing the left and right sides of the intestine with the bladders and ducts. *ve,* ventriculus; *si,* small intestine; *bl,* bladder; *o,* duct opening into the small intestine.

FIG. 5. Dorsal view of the ventriculus, showing the arrangement of the Malpighian tubules. *2nd,* second abdominal segment; *9th,* ninth abdominal segment; *xx,* region in which the free ends of the Malpighian tubules and the adipose tissue interweave into a dense mass.

FIG. 6. Ventral view of the ventriculus, showing the arrangement of the Malpighian tubules. Labels as in figure 5.

FIG. 7. Malpighian tubules under the microscope, showing the nodules. This piece of the tube occurred just posterior to where a dorsal tube turns caudad. *t,* tubule; *n,* nodule.

FIG. 8. Section from the Malpighian tubule toward the distad end, just anterior to the highly convoluted area. The nodules are quite numerous here and the tube thickened. *t,* tube *n,* nodule.

FIG. 9. Highly magnified portion of the tubule, showing the disappearance of the trachæ on the nodules. *n,* nodule; *t,* tube; *tr,* trachea.

FIG. 10. Cross section of tubule.

FIG. 11. Cross section of tubule and nodules.

FIG. 12. Longitudinal section of tubule and nodule.
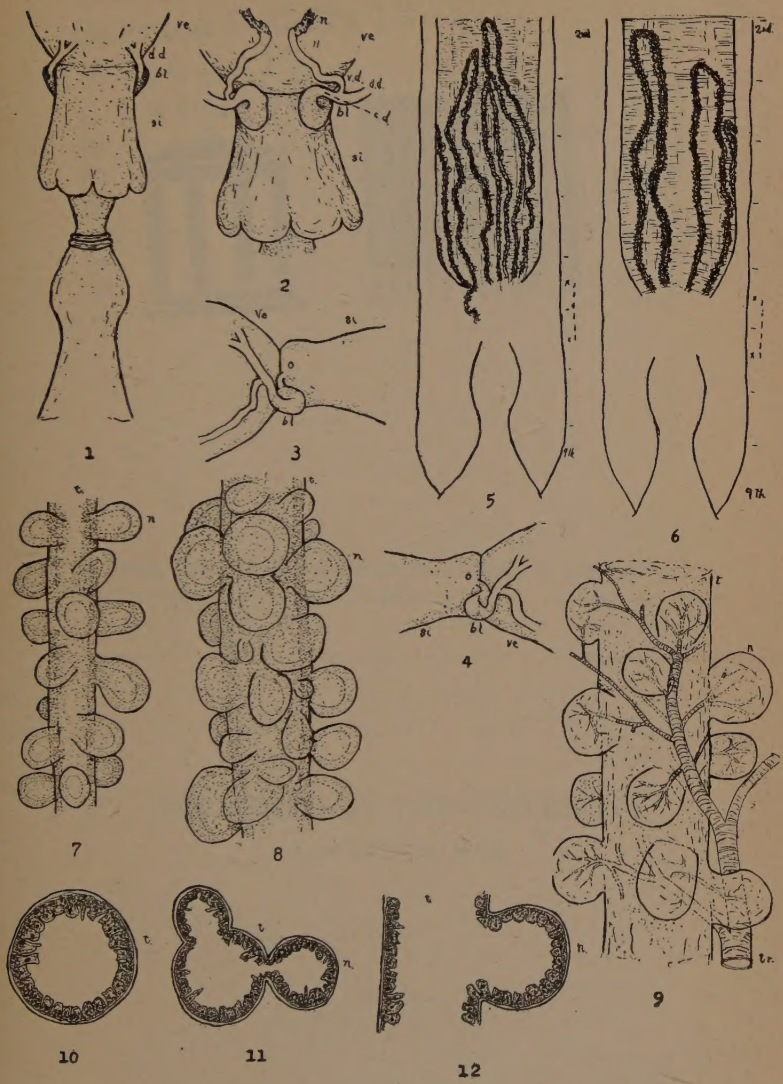
PLATE XXXVIII.